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Abstract

IMPROVEMENT INTRODUCED INTO THE THERMAL TRANSFER OF NUCLEAR FUELS BY THE "VAPOTRON" PROCESS

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The efforts made with a view to reducing the cost of the electric power of nuclear origin are being pursued along different lines, one of them being the increase in specific power (expressed in kW per liter). Progress in this respect consist either in increasing the thermal power produced inside the fuel proper (e.g. by increasing the neutron flux) or in improving the conditions under which this energy will be transferred into the form under which it will be used for transformation into electricity.

In the case of reactors using uranium oxyde, it was feared for a long time that the specific energy released within the fuel might be severely limited by the maximum temperature at the center of the rod. Actually, it was noted that the thermal conductivity of the fuel could be improved and furthermore that a central fusion did not necessarily have any serious effect on the operation. Consequently, the problem of the transmission of this energy to the coolant mixture (water and steam) is once more to the fore.

It is interesting to note that practically all laboratories working on this problem - many of them with considerable means - are exclusively interested in the thermal exchanges occuring on isothermal surfaces (e.g. cylindrical canning or plates). The authors on the contrary have studied the phenomenon of two-phase exchange on non isothermal canning. These particular structures are fitted with ribs or fins on which is set up a stable temperature gradient particularly

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favourable to an exchange by boiling. This special type of exchange by boiling was developed up to a point where, under certain precise thermodynamic conditions, remarkable manifestations known as the "Vapotron effect" were obtained.

The authors describe first the results obtained on cans of this type, in various testing facilities designed to reproduce the thermodynamic conditions of a reactor. It will be seen that the performances achieved promise exchange coefficients much higher than those generally accepted. The very great increase in safety will also be illustrated allowing in particular a set-back of the burn-out conditions (often leading to fuel element melting).

They explain how such a system can be made to fit into the present concept of reactors in which the heat transfer is chiefly achieved by boiling, what essential differences it would cause in their structure, taking into account the technological requirements, and finally they indicate a balance sheet explaining the main advantages of the "Nuclear Vapotron system" on technical and economic grounds.